

Homework

→ An object of mass 1.5 kg travelling in a straight line with a velocity of 5 m/s collides with a wooden block of mass 5 kg resting on the floor. The object sticks with wooden block after collision & both move together in a straight line.

i) The total momentum after collision is :-

→ 7.5 kg m/s

ii) The velocity of the combination of these objects after collision is :-

→ 1.5 m/s

2) A 20 kg bullet can fire 10 bullets per second. Mass of each bullet 0.2 kg . The muzzle speed of the bullet is 150 m/s . What is the recoil velocity of the gun? How much force is required to hold the gun?

mass of the gun = M

mass of the bullet = m

velocity of the bullet = v

Recoil velocity of the gun = V

→ $V = -mv/M$

→ $V = \frac{0.2 \times 150}{20}$

1.5

$$\Rightarrow v = \frac{-30}{20} = \frac{-3}{2} = -1.5 \text{ m/s}$$

∴ The recoil velocity is 1.5 m/s (gun moves opposite side of the bullet)

The required force :-

↳ Change in momentum per second due to bullets

$$\text{Momentum of one bullet} = p = mv$$

$$= 0.2 \times 150$$

$$= 30 \text{ kg m/s}$$

$$N = \text{no. of bullet per sec} = 10$$

∴ $\frac{dp}{dt}$ = change in momentum.

$$N(p - 0) = 10(30) = 300 \text{ N force required}$$

3) State & prove law of conservation of linear momentum

Suppose A & B two objects of mass m_1 & m_2 are moving in the same dirⁿ with velocity u_1 & u_2 respectively ($u_1 > u_2$). Object A collides with object B & after time t both move in the original dirⁿ with velocity v_1 & v_2 respectively.

The change in momentum of obj. A is $m_1 v_1 - m_1 u_1$
The force on B by A is $F_1 = \frac{\text{change in momentum}}{\text{time}}$

$$= F_1 = \frac{m_1 v_1 - m_1 u_1}{t} \quad \text{--- (1)}$$

The change in momentum of object B is $m_2 v_2 - m_2 u_2$

$$\text{The force on A by B is } = F = \frac{m_2 v_2 - m_2 u_2}{t} \quad \text{--- (2)}$$

Newton's Third law

$$F_1 = F_2$$

$$\frac{m_1 v_1 - m_1 u_1}{t} = - \frac{(m_2 v_2 - m_2 u_2)}{t}$$

$$\Rightarrow m_1 v_1 - m_1 u_1 = m_2 v_2 - m_2 u_2$$

$$\Rightarrow m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

\rightarrow initial momentum = final momentum
proved

~~If~~ A bomb explodes into several parts, why these parts fly off in different directions.

The conservation of momentum demands that final momentum should be zero. The several parts carry equal & opposite momentum to make total momentum zero. Thus these parts move in different dirⁿ.